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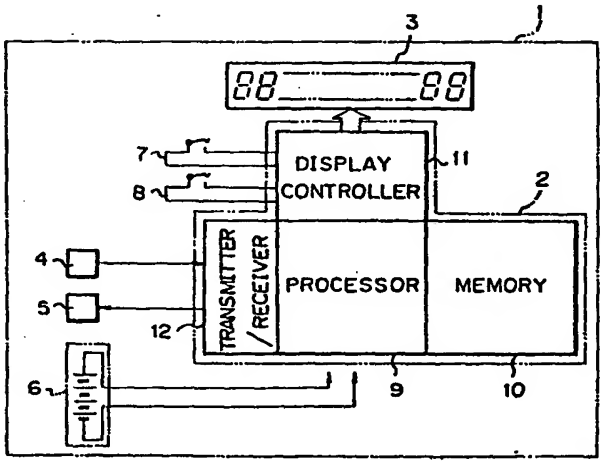
(54) IC card and IC card reader.

(57) An IC card includes an integrated circuit composed of a transmitter/receiver, a processor, a memory, and a display controller; a display, and control switches for successively switching data displayed on the display. Desired data stored in the memory can be displayed on the display by a command delivered through the transmitter/receiver or actuation of the control switches. An IC card reader for reading the IC carc includes signal transmitting and receiving circuits for transmitting signals to and receiving signals from the IC card, and a control unit for displaying the stored data on the display of the IC card dependent on processed results.



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SPECIFICATION

IC CARD AND IC CARD READER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an information card having a semiconductor IC encapsulated in an insulating plastic substrate for use as a validation card, an admission checking card, a credit card, or the like in business transactions and personal identification, and more particularly to an IC card having a display capability and an IC card reader for reading recorded information from such an IC card.

2. Description of the Related Art

Automatic cash dispensing and depositing machines in banks and other monetary organizations are operated to dispense or deposit bank notes by cash cards inserted by the customers who enter necessary input data into the machine. The details of the transaction are recorded on a slip issued from the machine or on the passbook which is inserted by the customer into the machine.

The conventional automatic cash dispensing and depositing machines are however disadvantageous in that the customers are required to handle three different mediums, i. e., the cash card, the bank note, and the slip or passbook, independently or in combination, a process which has been complex to make in connection with the machine.

The automatic cash dispensing and depositing machine is required to have a cash dispensing and depositing ability, an ability to read data from the magnetic stripes on cash cards, an

ability to print transaction details on slips and issue them, and an ability to print transaction details on passbooks. Therefore, the machine has been complicated in structure and expensive to manufacture.

There have recently been proposed IC cards and IC card readers, the IC card being composed of a semiconductor IC including a data processing circuit and a memory circuit and encapsulated in a insulating card substrate. However, the proposed IC cards and ICcard readers have not yet been successful in solving the aforesaid problems.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an IC card having a business transaction ability, a personal identification ability, a data recording and reading ability, and a data displaying ability for simplifying a process which is required to make in connection with a machine such as an automatic cash dispensing and depositing machine.

Another object of the present invention to provide an IC card reader designed to reduce the cost of manufacture of a machine such as an automatic cash dispensing and depositing machine in which the IC card reader is incorporated.

To achieve the above objects, an IC card includes an integrated circuit composed of a transmitter/receiver, a processor, a memory, and a display controller, a display, and control switches for successive switching of the display.

Data items can be stored into the memory through the transmitter/receiver and the processor, and read out of the memory through the transmitter/receiver and the processor. Desired data which is stored in the memory can be displayed on

The processor 9 successively processes the parallel data and judges the same as the data readout command for reading the personal indentification data in a step 105. The processor 9 then reads necessary data from the addresses of the memory 10 where the personal indentification data is stored, in a step 106, and sets the read-out data as transmission data in the transmitter/receiver 12. The transmission data or parallel data is converted by the transmitter/receiver 12 to serial data which is transmitted as an optical signal through the driver 18 and the signal transmitting means 5 to the receiver 22 of the IC card reader 20 in a step 107.

When the data is received as an optical signal by the receiver 22, the optical signal is converted by the received-signal converter 26 to a logic signal which is then fed to the processor/memory 21. The processor/memory 21 successively processes data in the form of the received logic signal, and transfers the processed data to the controller of the automatic cash dispensing and depositing machine (not shown) in a step 108.

The automatic cash dispensing and depositing machine compares the processod data, i.e., the personal indentification data with the customer's code number entered through another means by the customer. If the data and the customer's code number coincide and the depositing conditions are met, then the automatic cash dispensing and depositing machines dispenses the amount of money which the customer has specified through another means in a step 109.

Recording of transaction details:

When the cash dispensing transaction is established, the automatic cash dispensing and depositing machine issues a command for recording transaction details and data on the

transaction details to the IC card reader 20 in a step 111.

In response to the output signal from the automatic cash dispensing and depositing machine, the processor/memory 21 of the IC card reader 20 transmits an optical signal through the driver 25 and the transmitter 23 to the signal receiving means 4 of the IC card 1, thus delivering the recording command and the transaction details data to the IC card 1 in a step 112.

The transaction details data received by the IC card 1 is stored through the received-signal converter 17, th transmitter/receiver 12, and the processor 9 into addresses in the memory 10 which are reserved for writing latest data therein, in steps 113, 114, 115. Information indicating that the transaction details data has been recorded is then transmitted via the transmitter/receiver 12, the driver 18, and the signal transmitting means 5 to the receiver 22 of the IC card reader 20 in steps 116, 117, 118.

Display of transaction details:

When the information indicating the completion of data recording is received from the receiver 22 through the received-signal converter 26 and the processor/memory 21, a command for displaying the latest transaction details is isseud from th processor/memory 21 through the driver 25 and the transmitter 23 to the signal receiving means 4 of the IC card 1 in steps 121, 122, 124.

When the command for displaying the latest transaction details is received by the IC card 1 from the signal receiving means 4 through the received-signal converter 17 and the transmitter/receiver 12 in steps 125, 126, the processor 9 reads the latest data of transaction details out of the addresses thereof in the memory 10 in a step 127, and transfers the data to

the display controller 11 in a step 128. The display controller 11 displays the latest data on the display 8 through the driver 19 in a step 129.

Instead of delivering the command for displaying the latest transaction details through the signal receiving means 4 of the IC card 1 in the steps 123, 124, 125, the presser lever 40 (FIG.4) of the IC card reader 20 may be actuated to depress the control switch 8 in steps 131, 132 to enable the processor 9 to read the latest transaction details data from the addresses of the memory 10. Then, the data is tranferred to the display controller 11 in the step 126, 127, 128. The display controller 11 displays the latest data on the display 8 through the driver 19 in the step 129.

Therefore, the stored data to be displayed on the display 3 of the IC card 1 under the command of the IC card reader 20 may be controlled by either the means which transmits the command from the processor/memory 2 via the driver 25 and the transmitter 23 or the means which actuates the presser lever 40 under the control of the processor/memory 21.

After the latest transaction details data is displayed, information indicating the completion of display is transmitted from the transmitter/receiver 12 through the driver 18 and the signal transmitting means 5 to the receiver 22 of the IC card reader 20 in a step 141. The receiver 22 then delivers the received information through the received-signal converter 26 to the processor/memory 21, which transfers the display completion information to the controller of the automatic cash dispensing and depositing machine in a step 142. In response to the display completion information, the automatic cash dispensing and depositing machine issues a command from its controller to return

the IC card 1 and dispenses the cash in a step 143.

The customer receives the cash and the IC card 1, and can confirm the latest transaction details by looking at the display 3 of the IC card 1.

FIG. 6 shows the integrated circuit of an IC card according to another embodiment of the present invention, and FIG. 7 illustrates the process of operation of the IC card of FIG. 6.

When the customer is desirous of knowing past transaction details, they can be displayed on the display 3 each time the control switch 7 is depressed. When the customer thereafter wishes to know new transaction details again, the display 3 can be switched to display newer transaction details successively each time the control switch 8 is depressed. Such an operation is shown at (A) and (B) in FIG. 7, and will be described with reference to FIGS. 6 and 7.

When the control switch 7 is pushed by the customer - (A):

When the customer wishes to know one older transaction data through the display 3 of the IC card 1, the customer depresses the control switch 7 once in a step 201. The control switch 7 is actuated in a step 202, and the display controller 11 issues a signal representative of "present displayed data - 1" to the processor 9 in a step 203. In response to this signal, the processor 9 decides to "display one older transaction data" in a step 204, and effects the arithmetic operation "display addresses A0. An in the memory 10 = present address - 1" in a step 205. The present address is the address (indicated by Ax in FIG. 6) in the memory 10 where the transaction data now being displayed is stored. After the arithmetic operation is carried out by the processor 9, the processor 9 delivers the display address = A0 - An (Ax-y) and a readout signal READ to the memory 10 in a step

206. The memory 10 then delivers the transaction data in the indicated display address Ax-y as display data D0 - D7 to the processor 9 in a step 207. Having received the display data D0 - D7, the processor 9 transfers the display data D0 - D7 to the display controller 11 in a step 208. The display controller 11 issues a display command to the display 3 in a step 209, and the display 3 displays preceeding or one older transaction data in a step 210.

When the control switch 8 is pushed by the customer - (B):

When the customer wishes to know one newer transaction data again after he has known past transaction data, i.e., transaction data one newer than the transaction data displayed on the display 3, the customer depresses the control switch 8 once in a step 211. The control switch 8 is actuated in a step 212, and the display controller 11 issues a signal representative of "present displayed data + 1" to the processor 9 in a step 213. In response to this signal, the processor 9 decides to "display one newer transaction data" in a step 214, and effects the arithemetic operation "display addresses A0 - An = present address + 1" in the memory 10 in a step 215. Thereafter, the processor 9 delivers the display address = A0 - An (Ax+y) and a readout signal READ to the memory 10 in the step 206. The memory 10 then delivers the transaction data in the indicated display address Ax+y as display data D0 - D7 to the processor 9 in the step 207. The processor 9 then effects the same operation as described above in the steps 208 through 210.

In the foregoing operation, the data displayed on the display 3 is switched successively by actuating the control switch 7 or 8. However, the data displayed on the display 3 can also be switched successively by actuating the presser lever 39

or 40 in the IC card reader 20 as shown in FIG. 4. More specifically, after the customer inserts the IC card 1 into the card insertion slot 29 and made one desired transaction, the presser lever 40 is actuated once in a step 211 under the control of the IC card reader 20. The display 3 then displays one newer transaction data in the steps 212 through 215 and 206 through 210. By pulling the IC card 1 out of the card insertion slot 29, the customer can now know one newer transaction data. Since one newer transaction data is indicated each time one transaction is made, the presser lever 40 should be actuated N times when N transactions are made. Thus, the customer can know the newest transaction data each time he pulls out the IC card 1. It can easily be understood that this operation is the same as that in the steps 131, 132 in FIG. 5.

The presser lever 39 is controlled to operate once in the step 210 when displaying data one older than the present displayed data. When the presser lever 39 is thus operated, the display 3 displays one older transaction data in the steps 202 through 210.

The flows (A), (b) in FIG. 7 are therefore representative of operations for successively switching the data displayed on the display 3, incrementally or decrementally, through the switches 7, 8.

Display of newer data- (C)

Now, operation for switching the data displayed on the display 3 of the IC card 1 under a command from the IC card reader 20 will be described.

The customer inserts the IC card 1 into the card insertion slot 29 (FIG. 4) and makes a transaction. Although normally one transaction is made at a time, N transactions such as depositing,

withdrawing, transferring, recording on the passbook, may be made at one time, and recorded as transaction details in the memory 10 of the IC card 1. At this time, the customer is likely to know the newest transaction data after all of the transactions have been made. Therefore, the display 3 is required to display data which is N times newer than the present displayed data.

The foregoing operation will be described with reference to the flow (C) of FIG. 7.

The IC card reader 20 issues out a command for displaying new data in a step 221. When this command is received by the signal receiving means 4 of the IC card 1 in a step 222, the transmitter/receiver 12 transfers a signal indicative of "present display data + N" to the processor 9 in a step 223. In response to this signal, the preocessor 9 decides to "display N newer transaction data" in a step 224, and effects the arithmetic operation "display addresses AO - An in the memory 10 = present address + N" in a step 225. Thereafter, the processor 9 delivers the display address = AO - An in the memory 10 = present address + N" in a step 225. Thereafter, the processor 9 delivers the display address = AO - An (Ax + Ny) and a readout signal READ to the memory 10 in the step 206. The memory 10 then delivers the transaction data in the indicated display address Ax + Ny as display data DO - D7 to the processor 9 in the step 207. The processor 9 then displays "N newer transaction data", i.e., the latest data on the display 3 in the steps 208 through 210.

In the above description, when N transactions are made, the display 3 displays the newest transaction data at all times by displaying the newer transaction data on the display 3. However, the IC card reader 20 may issue a command for displaying the N newer transaction data (where N = 1), i.e., one newer

transaction data. At any rate, the flow (C) of FIG. 7 is the same as the operation in the steps 124 through 129 in FIG. 5.

Display of older data - (D):

M older transaction data can also be displayed after M transaction have been made. The number M has a meaning different from the number N as above in that M may be a certain number such as 5 or the number of transaction data items back to one month before, or a number specified by the customer with a control switch (not shown). In any case, the IC card reader 20 issues a command for displaying older data in a step 231. When this command is received by the signal receiving means 4 in a step 232, the transmitter/receiver 12 transfers a signal indicative of "present display data - M" to the processor 9 in a step 233. In response to this signal, the processor 9 decides to "display M older transaction data" in a step 234, and effects the arithmetic operation "display addresses AO - An in the memory 10 = present address - M" in a step 235. Thereafter, the processor 9 delivers the display address = AO - An (Ax - My) and a readout signal READ to the memory 10 in the step 206. The memory 10 then delivers the transaction data in the indicated display address Ax - My as display data DO - D7 to the processor 9 in the step 207. The processor 9 then displays "M older transaction data" on the display 3 in the steps 208 through 210. The customer can now know the M older transaction data by pulling his IC card 1 out of the card insertion slot 29.

If there is no display command or the presser levers are not actuated - (E):

The flow (E) of FIG. 7 shows an operation in which there is no display command from the IC card reader 20 or the presser levers 39, 40 are not actuated. In this operation the IC card

reader 20 does not effect the control for the display of newer data (C), the display of older data (D), the actuation of the presser lever 40 (B), and the actuation of the presser lever 39 (A). When the IC card 1 receives transaction data from the IC card reader 20, the received data is written into the memory 10 and displayed under the control of the IC card 1 itself. Therefore, any older data is not displayed, but N transaction data items are written into the memory 10 and displayed on the display 3. As a consequence, the customer can know the latest transaction data by pulling the IC card 1 out of the card insertion slot 29 (FIG. 4).

The operation will be described with reference to the flow (E) of FIG. 7.

When transaction data is received through signal receiving means in a step 241, the transaction data is transferred by the tgransmitter/receiver 12 to the processor 9 in a step 242. The processor 9 then edits the transaction data for each transaction in a step 243. The N transaction data are then written from the processor 9 into the memory 10 in a step 244, the data including AO - An = writing data, and an N data writing signal WRITE. The processor 9 then processes the display address Ax - NY for the latest transaction data among display the N transaction data. The processor 9 delivers the display address = AO - An (Ax + Ny) and a readout signal READ to the memory 10 in the step 206. The memory 10 then delivers the transaction data in the indicated display address Ax + Ny as display data DO - D7 to the processor 9 in the step 207. The processor 9 then displays "N newer transaction data" in the steps 208 through 210 in the same manner as decribed above. The customer can now know the newest transaction data by pulling the IC card 1 out of the card

insertion slot 29.

With the arrangement of the present invention, the IC card having the control switches, the display controller, the display, the transmitter/receiver, the processor, and the memory is controlled by the control switches and the external device or IC card reader for automatically recording data in, reading data from, and displaying data on the IC card. Therefore, the IC card can double as a business treansaction card and a personal identification card, and the customer is not required to carry and store a passbook and slips of transaction details.

Since theautomatic cash dispensing and depositing machine incorporating the IC card reader is not required to be equipped with a device for recording data on passbooks and a device for issuing slips of transaction details, the automatic cash dispensing and depositing machine can be smaller in size and less costly to manufacture.

The IC card reader of the present invention has a memory for storing data on effectiveness such as personal identification or various data dependent on different application, so that the data can be retriever for the IC card only. The IC card reader can therefore be widely utilized for reading data from admission checking cards, credit cards, and validation cards.

Although certain preferred embodiments have been shown and described, it should be understood that many changes and modifications may be made therein without departing from the scope of the appended claims.

What is claimed is:

1. An IC card comprising: an integrated circuit composed of a transmitter/receiver, a processor, a memory, and a display controller; a display, and control switch means for successively switching data displayed on said display, the arrangement being such that desired data stored in said memory can be displayed on said display by a command delivered through said transmitter/receiver or actuation of said control switch means.

2. An IC card according to claim 1, wherein said control switch means includes a control switch for switching said display to display one newer transaction data.

3. An IC card according to claim 1, wherein said control switch means includes a control switch for switching said display to display one older transaction data.

4. An IC card comprising: an integrated circuit composed of a transmitter/receiver, a processor, a memory, and a display controller; a display, said memory being capable of storing data delivered through said transmitter/receiver, and means for controlling the displaying of latest data on said display, the arrangement being such that the latest data among the data stored in said memeory can be displayed on said display.

5. An IC card reader for reading an IC card having an integrated circuit encapsulated in a substantially insulated substrate and including means for transmitting and receiving signals, a display for displaying data stored in a memory of said integrated circuits, control switches for switching data displayed on said display, and power supply means, said IC card reader comprising signal transmitting and receiving means for transmitting signals to and receiving signals from said IC card, and control means for displaying the stored data on said display

of said IC card dependent on processed results.

6. An IC card reader according to claim 5, wherein said control means comprises presser levers for actuating said control switches of said IC card.

7. An IC card reader according to claim 5, wherein said IC card reader further includes a processor/memory for supplying commands to said display controller of said IC card through a transmitter, said processor/momory having said control means.

Fig. 1

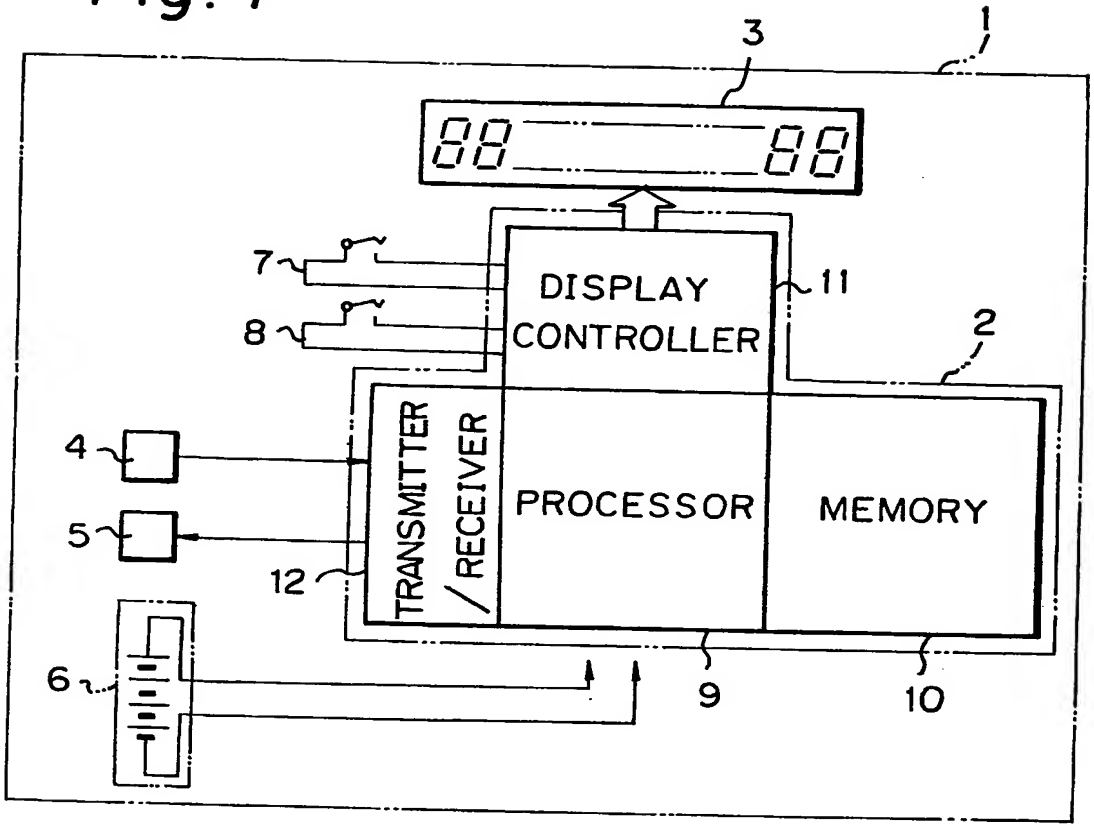


Fig. 2

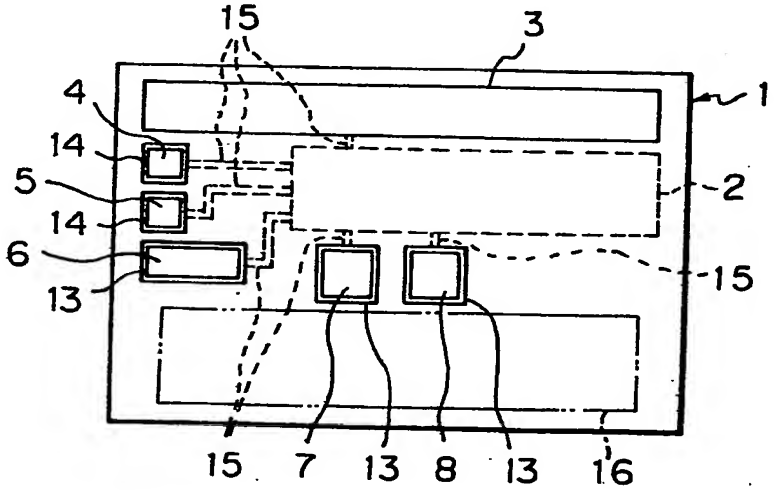


Fig. 3

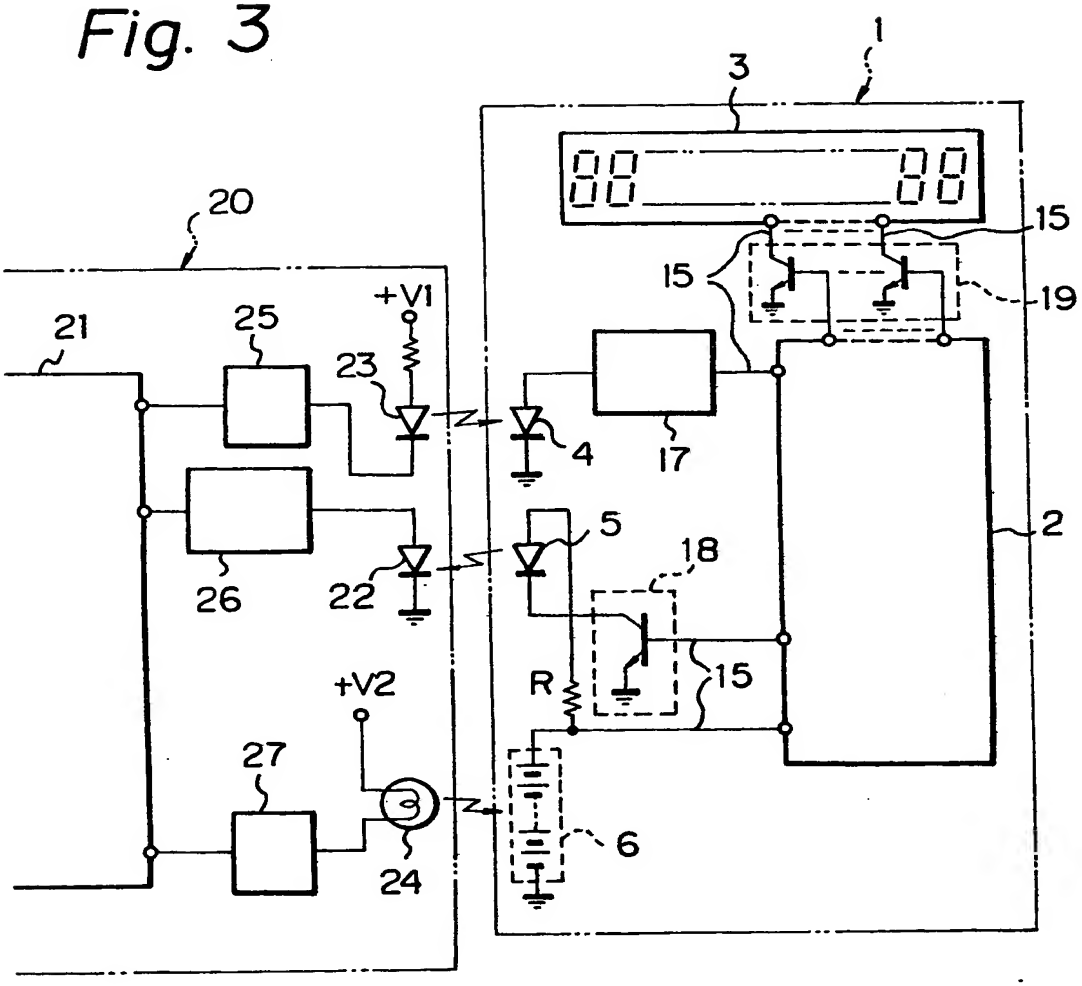

1
3
20
15
19
21
25
+V1
23
4
17
2
5
18
26
22
R
15
+V2
27
6
24

Fig. 4

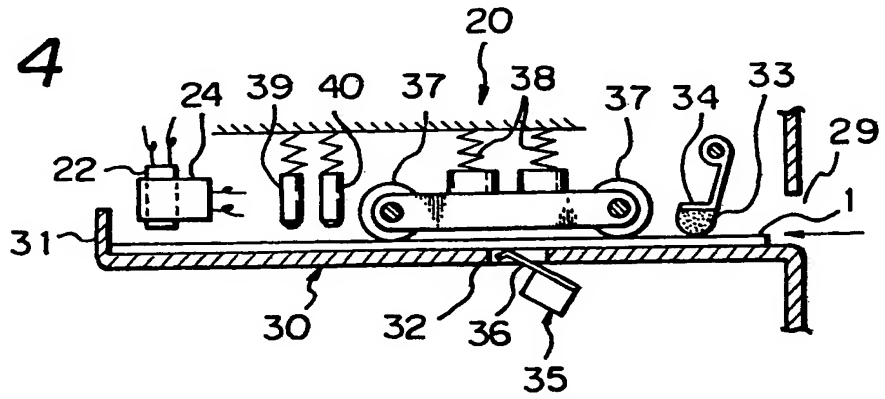

20
24
39
40
37
38
37
34
33
29
22
1
31
30
32
36
35

Fig. 5

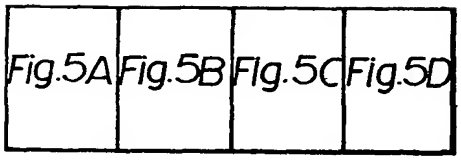


Fig.5A
Fig.5B
Fig.5C
Fig.5D

Fig. 5A

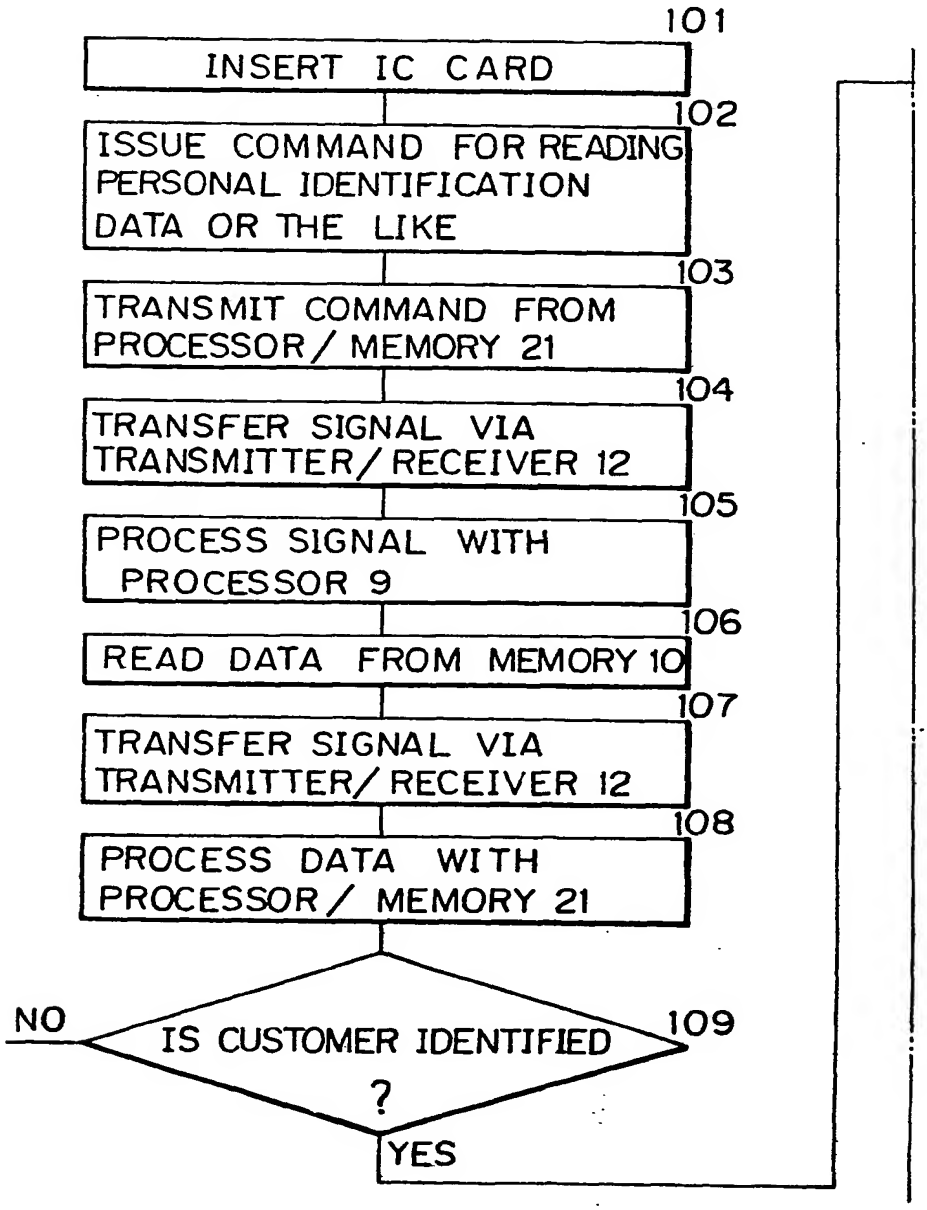

101
INSERT IC CARD
102
ISSUE COMMAND FOR READING PERSONAL IDENTIFICATION DATA OR THE LIKE
103
TRANSMIT COMMAND FROM PROCESSOR / MEMORY 21
104
TRANSFER SIGNAL VIA TRANSMITTER / RECEIVER 12
105
PROCESS SIGNAL WITH PROCESSOR 9
106
READ DATA FROM MEMORY 10
107
TRANSFER SIGNAL VIA TRANSMITTER / RECEIVER 12
108
PROCESS DATA WITH PROCESSOR / MEMORY 21
NO
IS CUSTOMER IDENTIFIED ?
109
YES

Fig. 5B

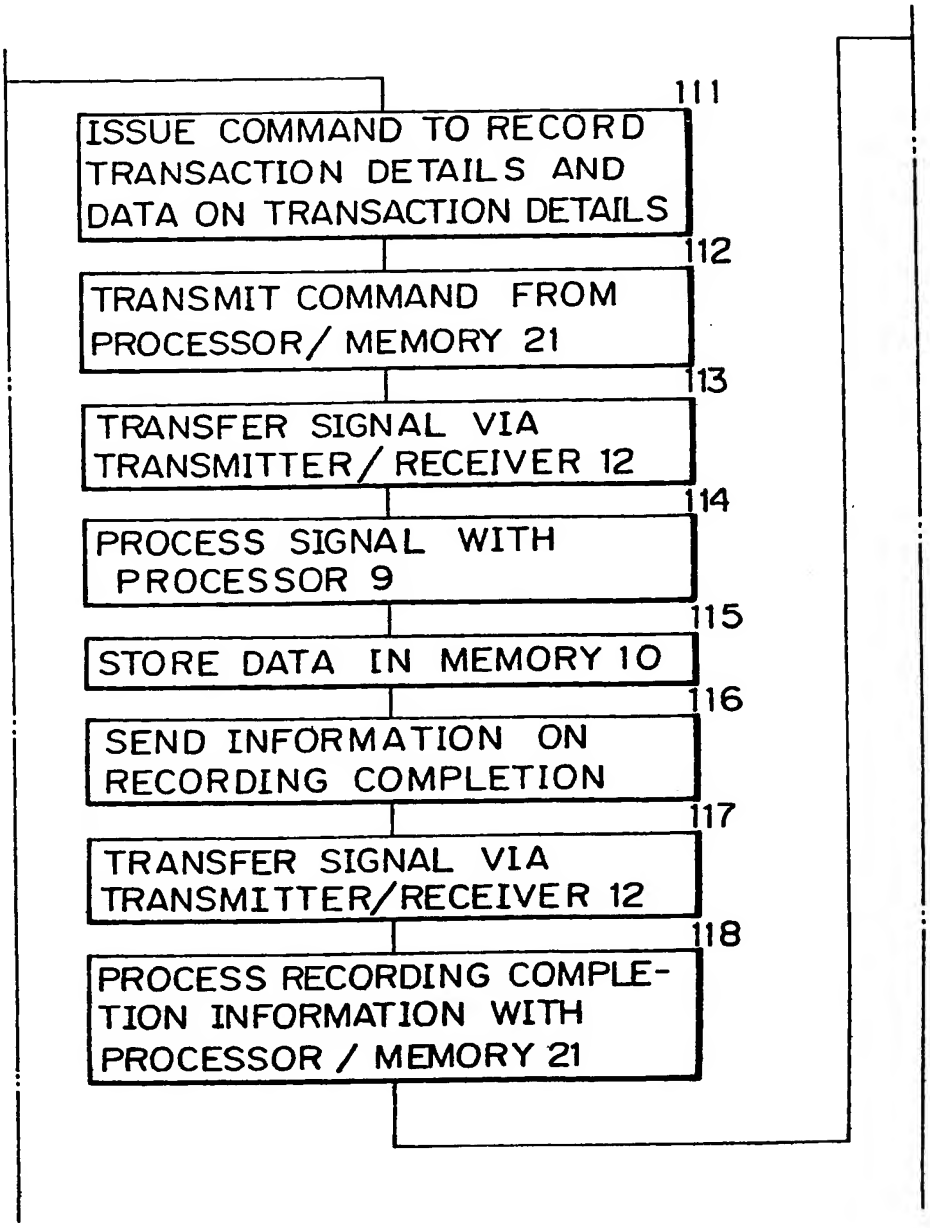

111
ISSUE COMMAND TO RECORD TRANSACTION DETAILS AND DATA ON TRANSACTION DETAILS
112
TRANSMIT COMMAND FROM PROCESSOR/ MEMORY 21
113
TRANSFER SIGNAL VIA TRANSMITTER/ RECEIVER 12
114
PROCESS SIGNAL WITH PROCESSOR 9
115
STORE DATA IN MEMORY 10
116
SEND INFORMATION ON RECORDING COMPLETION
117
TRANSFER SIGNAL VIA TRANSMITTER/RECEIVER 12
118
PROCESS RECORDING COMPLE-TION INFORMATION WITH PROCESSOR / MEMORY 21

Fig. 5C

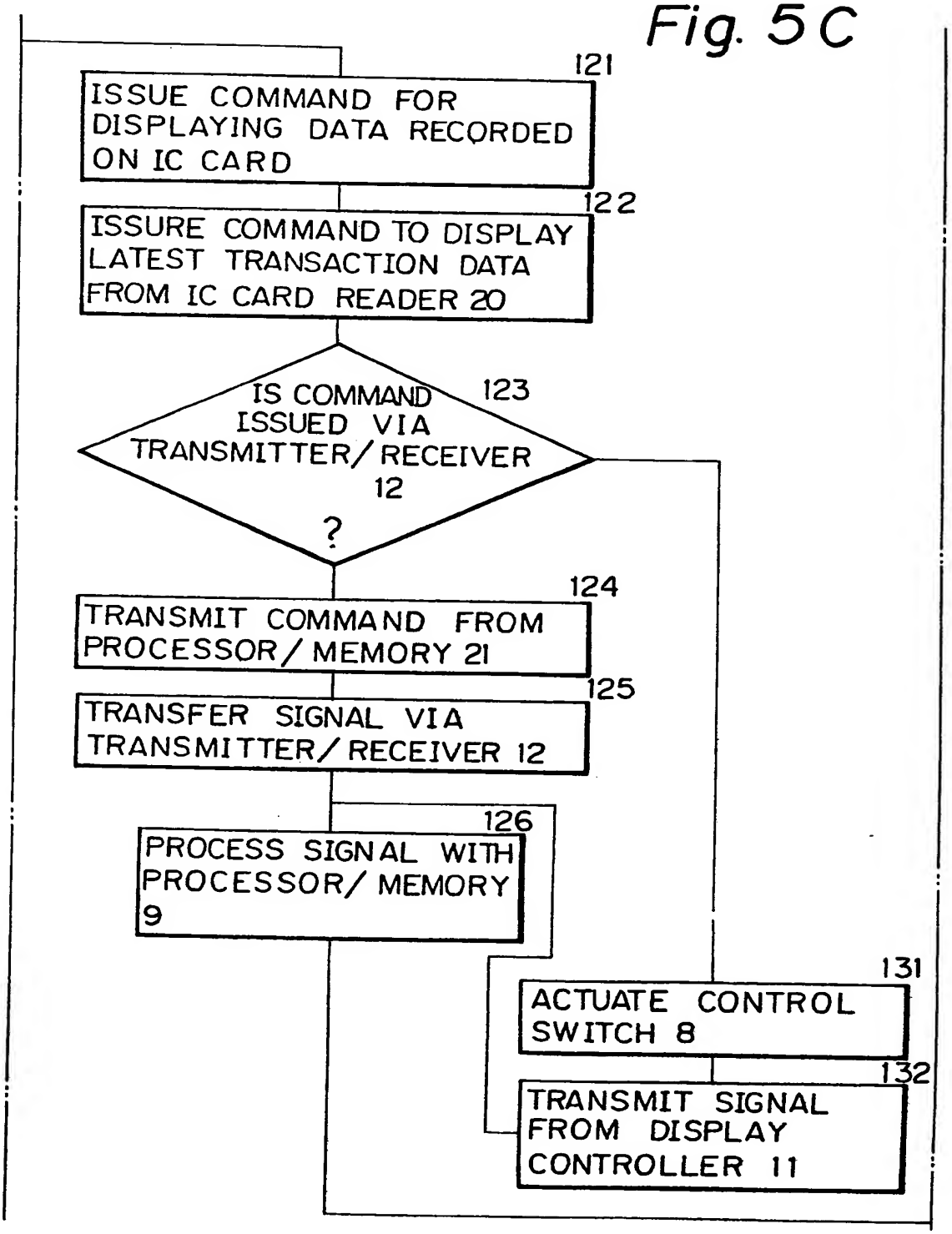


Fig. 5D

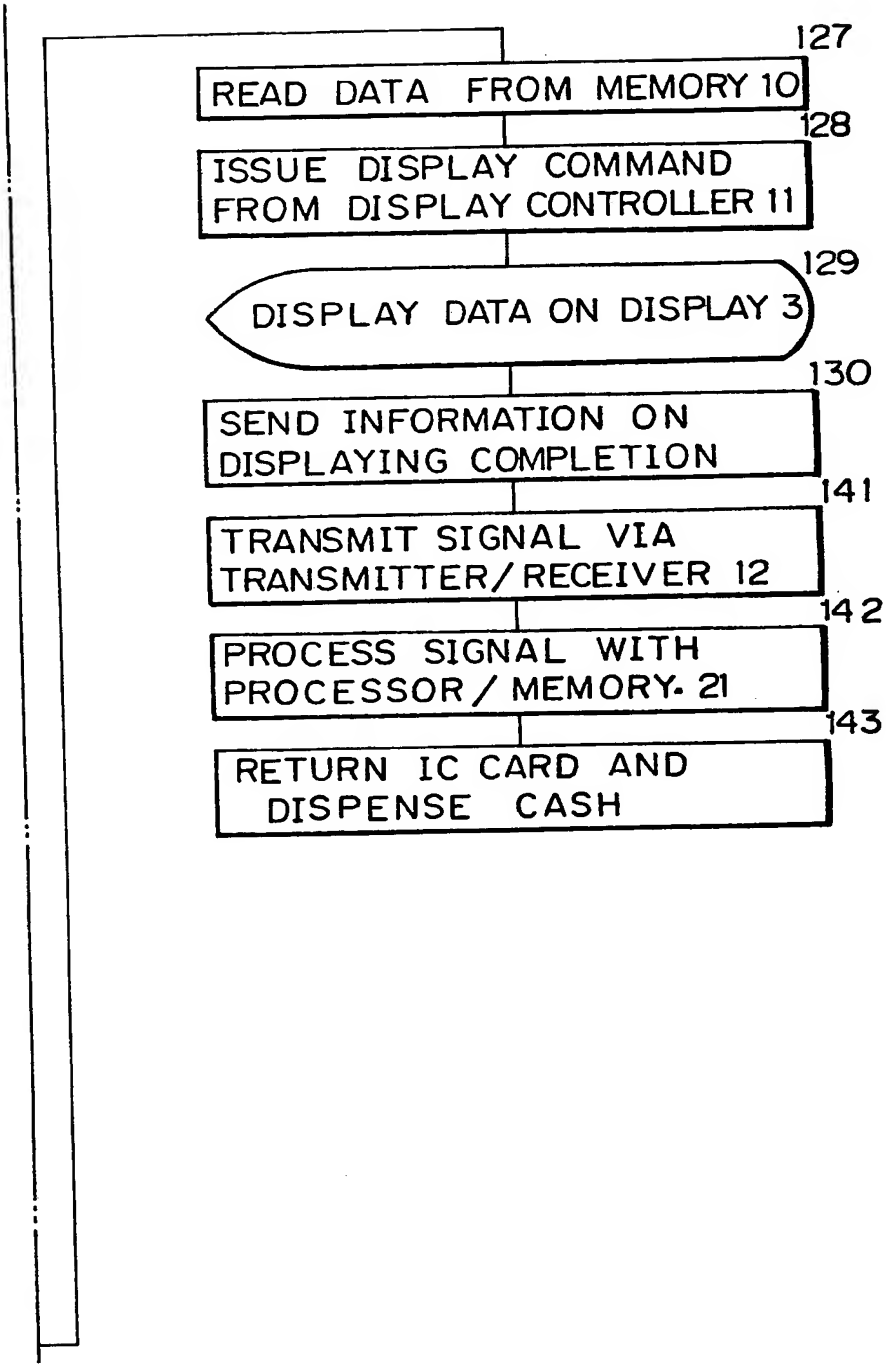
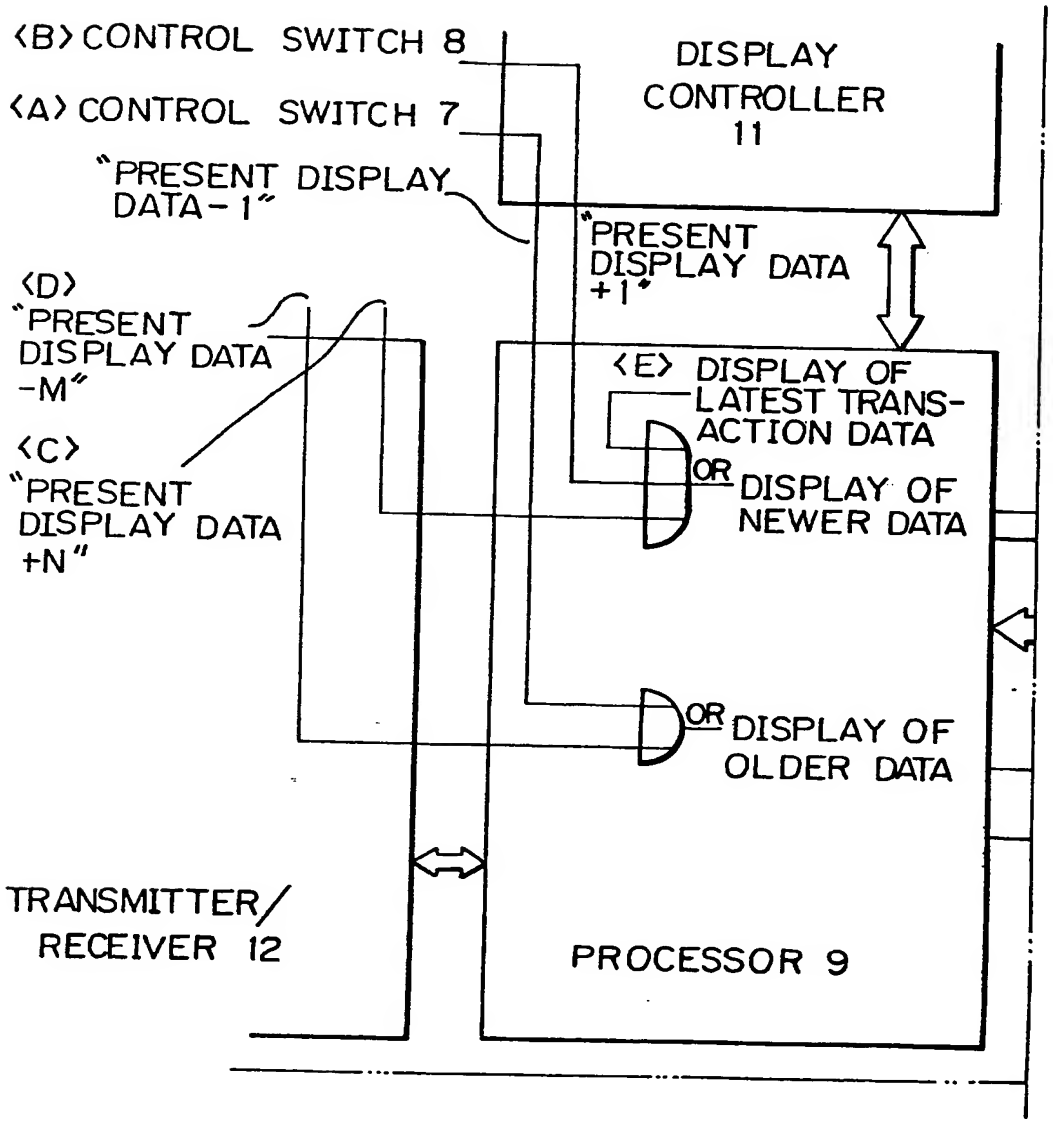

127
READ DATA FROM MEMORY 10
128
ISSUE DISPLAY COMMAND FROM DISPLAY CONTROLLER 11
129
DISPLAY DATA ON DISPLAY 3
130
SEND INFORMATION ON DISPLAYING COMPLETION
141
TRANSMIT SIGNAL VIA TRANSMITTER/RECEIVER 12
142
PROCESS SIGNAL WITH PROCESSOR/MEMORY 21
143
RETURN IC CARD AND DISPENSE CASH

Fig. 6A

Fig. 6

Fig.6A	Fig.6B



8/12

Fig. 6B

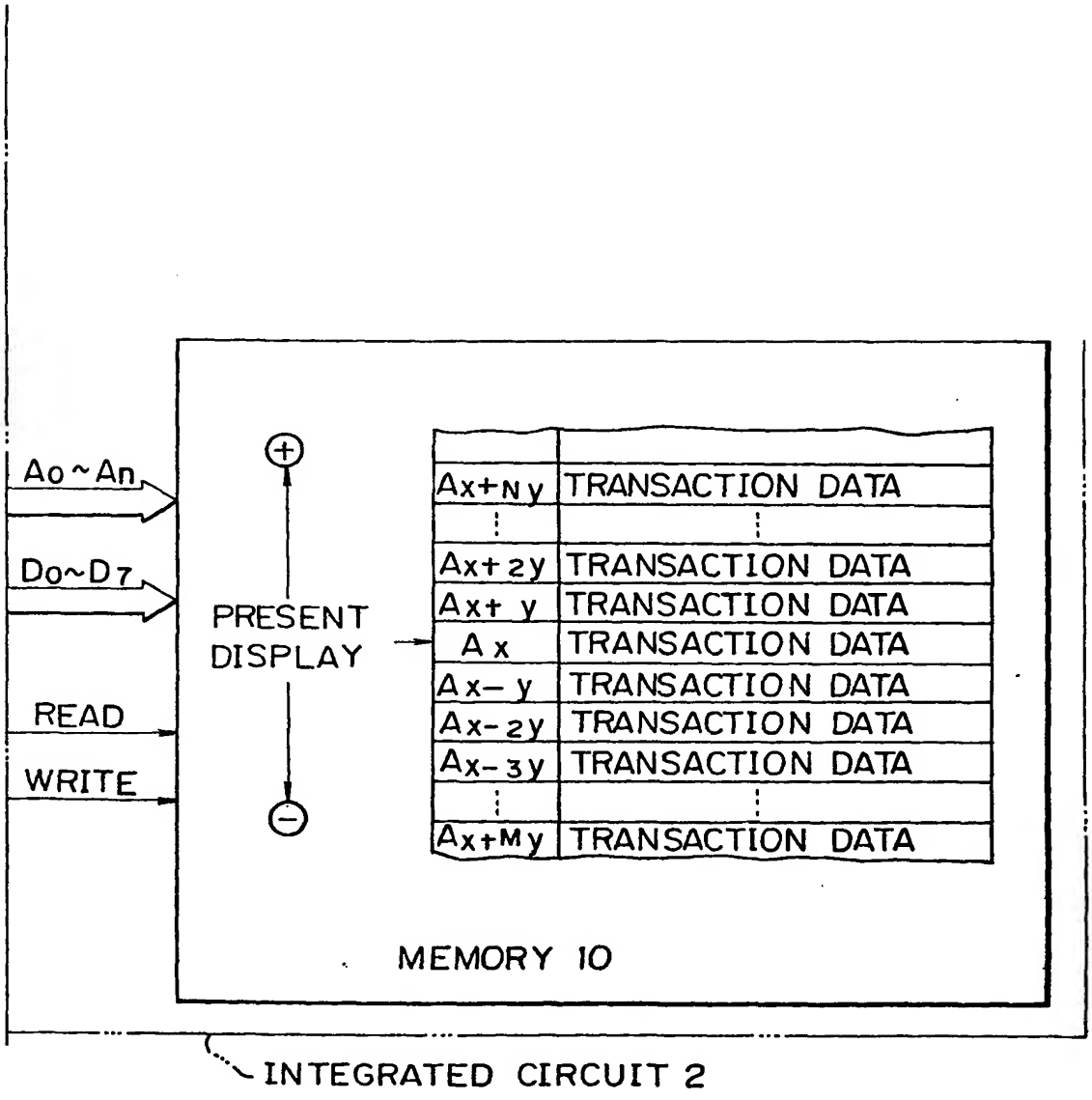
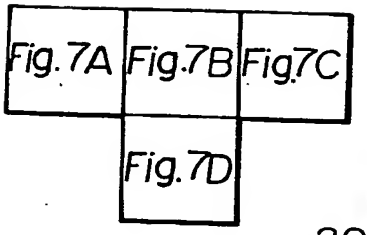

Ao~An
Do~D7
READ
WRITE
PRESENT DISPLAY
Ax+Ny TRANSACTION DATA
Ax+2y TRANSACTION DATA
Ax+y TRANSACTION DATA
Ax TRANSACTION DATA
Ax-y TRANSACTION DATA
Ax-2y TRANSACTION DATA
Ax-3y TRANSACTION DATA
Ax+My TRANSACTION DATA
MEMORY 10
INTEGRATED CIRCUIT 2

Fig. 7A

Fig. 7



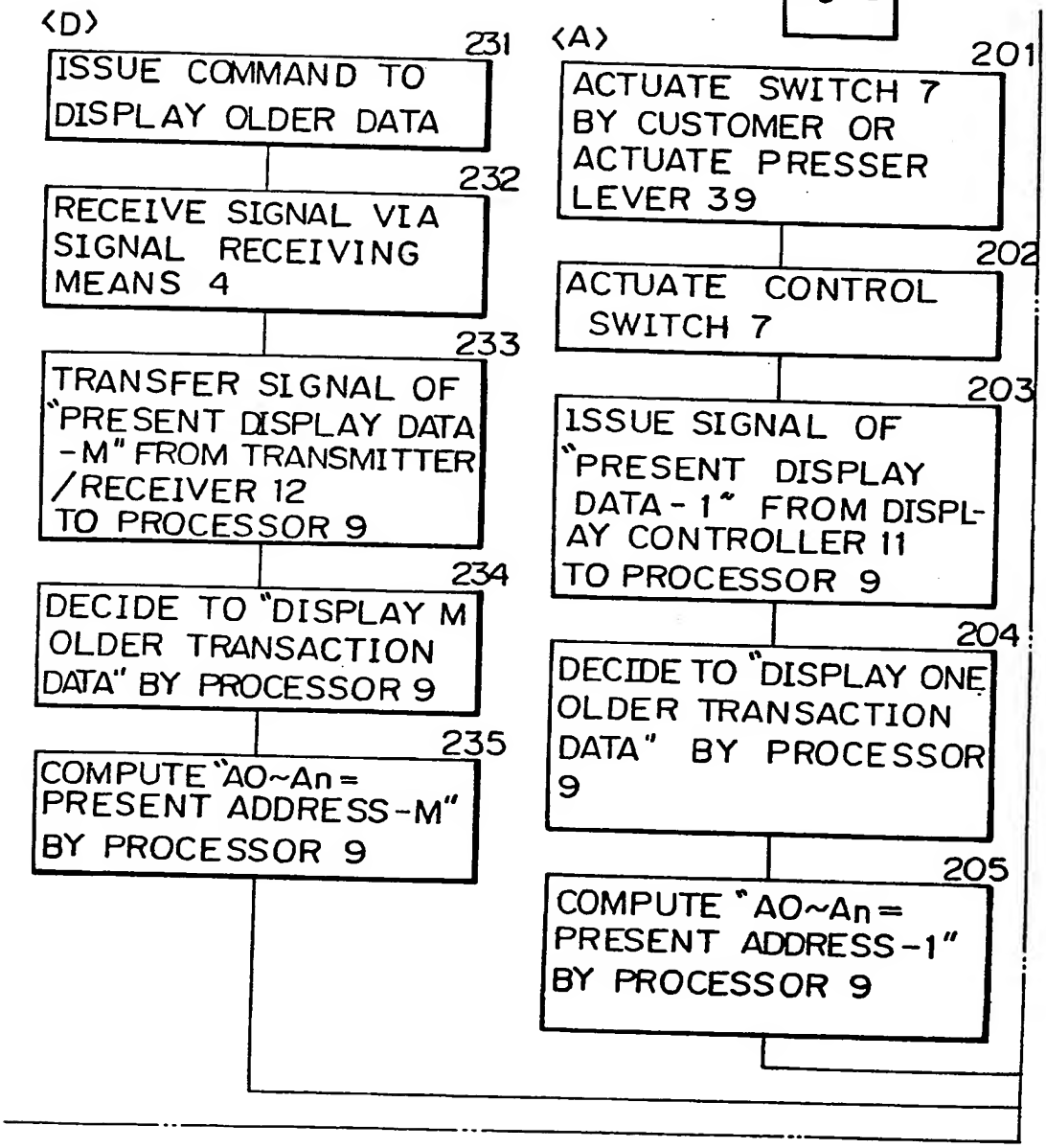


Fig. 7B

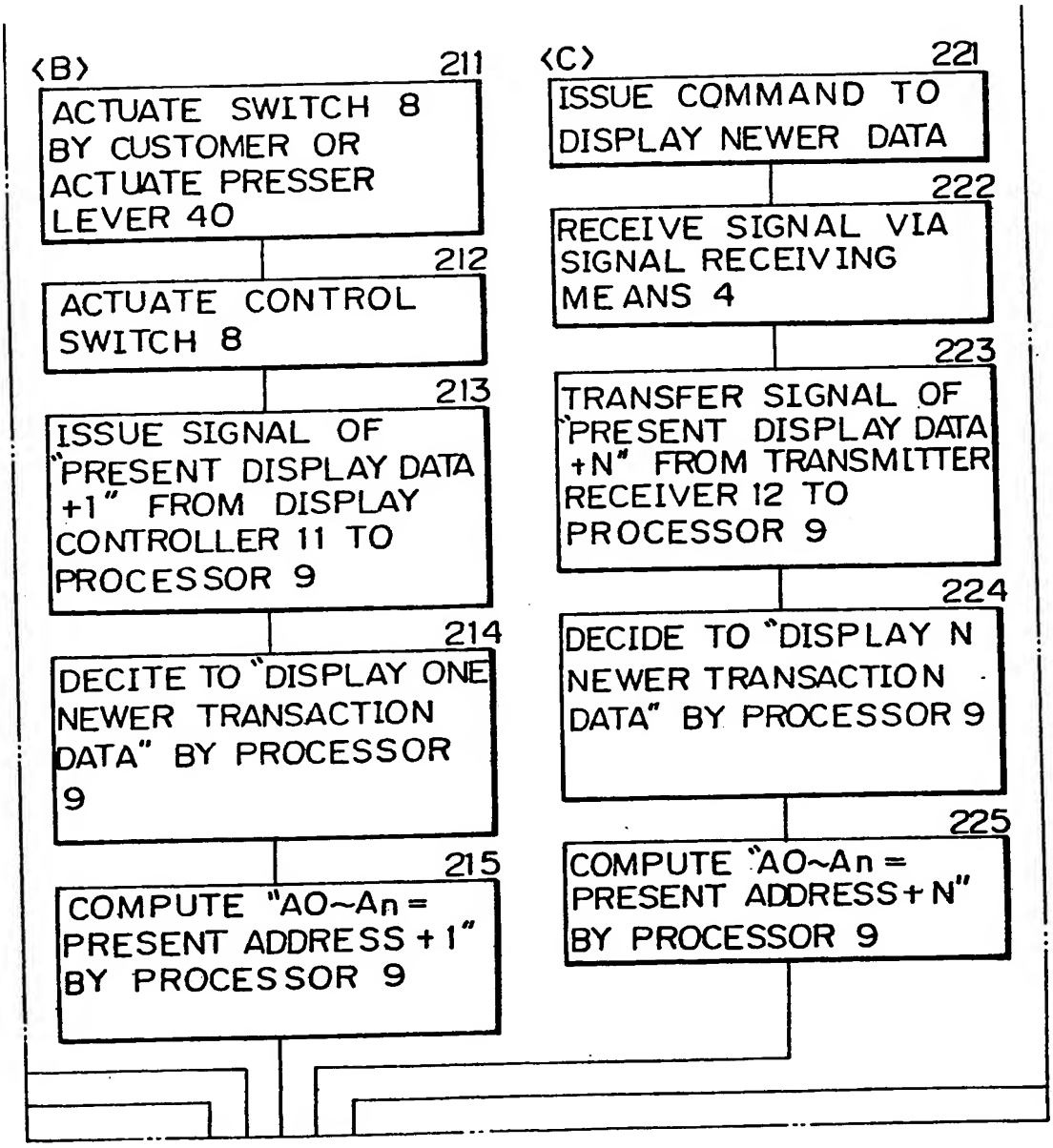

(B)
211
ACTUATE SWITCH 8 BY CUSTOMER OR ACTUATE PRESSER LEVER 40
212
ACTUATE CONTROL SWITCH 8
213
ISSUE SIGNAL OF "PRESENT DISPLAY DATA +1" FROM DISPLAY CONTROLLER 11 TO PROCESSOR 9
214
DECITE TO "DISPLAY ONE NEWER TRANSACTION DATA" BY PROCESSOR 9
215
COMPUTE "AO~An = PRESENT ADDRESS + 1" BY PROCESSOR 9
(C)
221
ISSUE COMMAND TO DISPLAY NEWER DATA
222
RECEIVE SIGNAL VIA SIGNAL RECEIVING MEANS 4
223
TRANSFER SIGNAL OF "PRESENT DISPLAY DATA +N" FROM TRANSMITTER RECEIVER 12 TO PROCESSOR 9
224
DECIDE TO "DISPLAY N NEWER TRANSACTION DATA" BY PROCESSOR 9
225
COMPUTE "AO~An = PRESENT ADDRESS+N" BY PROCESSOR 9

Fig. 7C

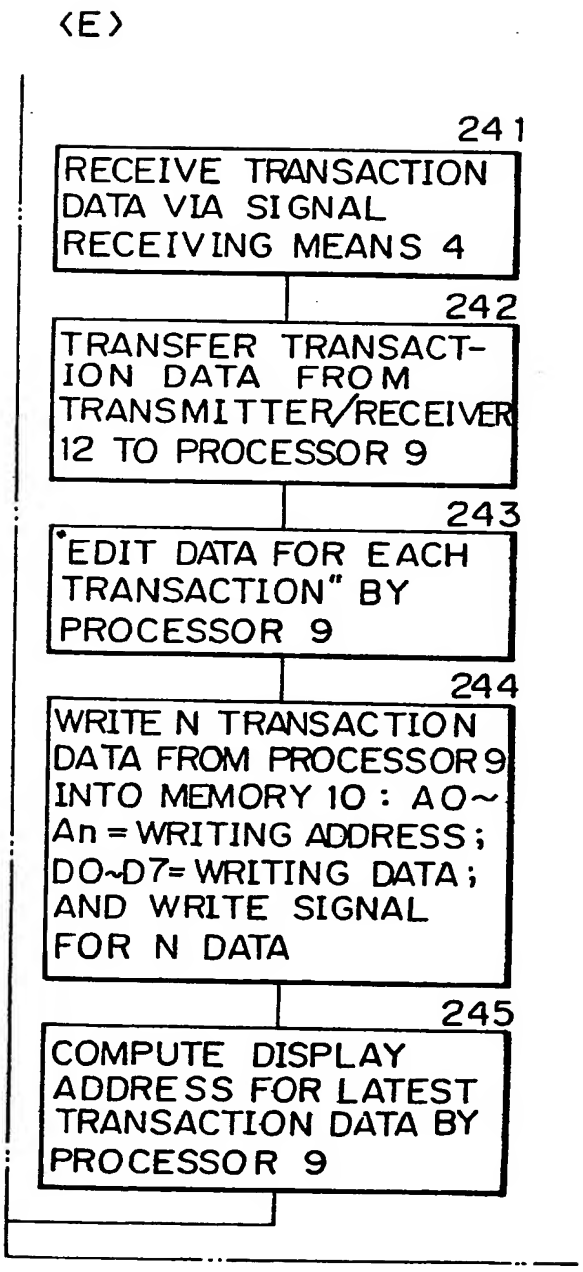
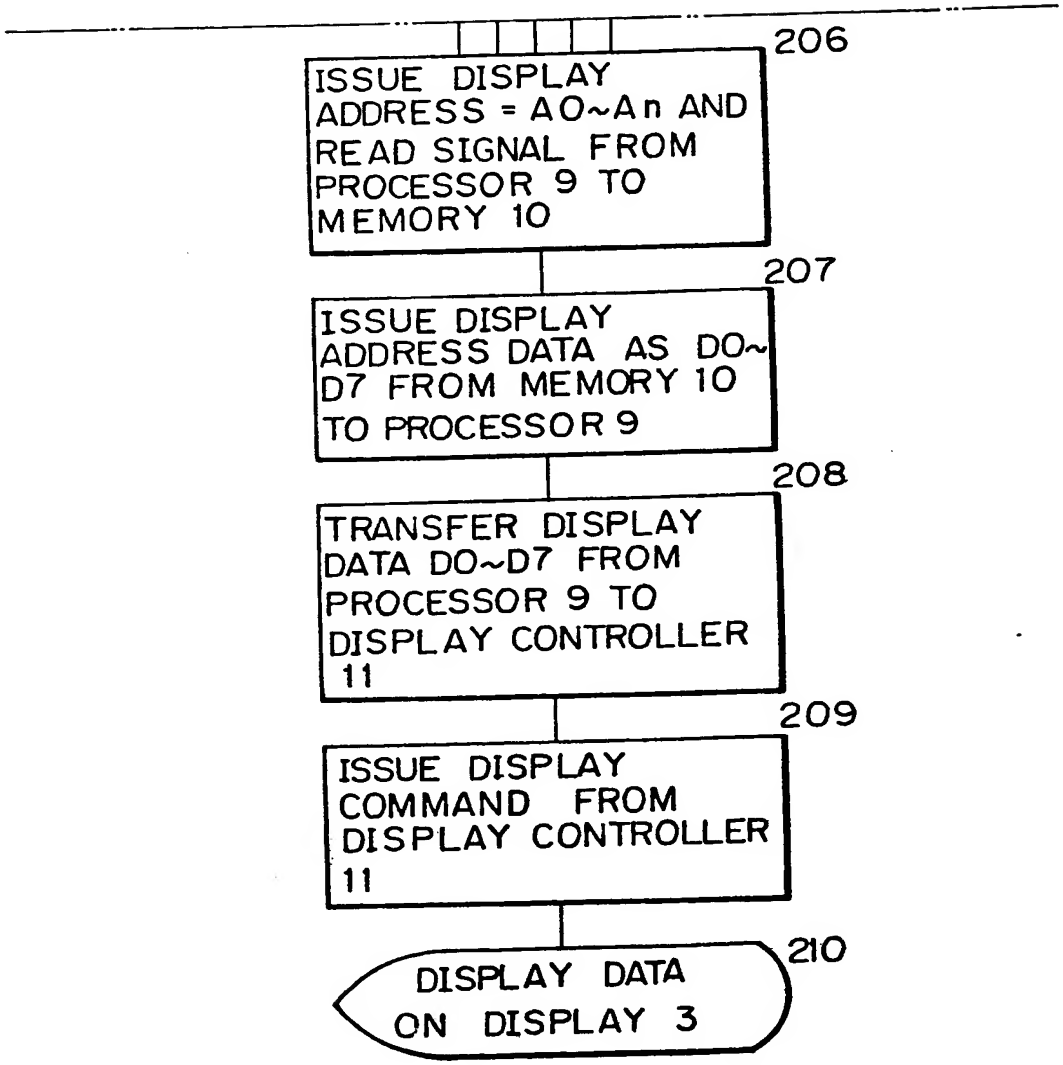


Fig. 7D


206
ISSUE DISPLAY ADDRESS = AO~An AND READ SIGNAL FROM PROCESSOR 9 TO MEMORY 10
207
ISSUE DISPLAY ADDRESS DATA AS DO~D7 FROM MEMORY 10 TO PROCESSOR 9
208
TRANSFER DISPLAY DATA DO~D7 FROM PROCESSOR 9 TO DISPLAY CONTROLLER 11
209
ISSUE DISPLAY COMMAND FROM DISPLAY CONTROLLER 11
210
DISPLAY DATA ON DISPLAY 3

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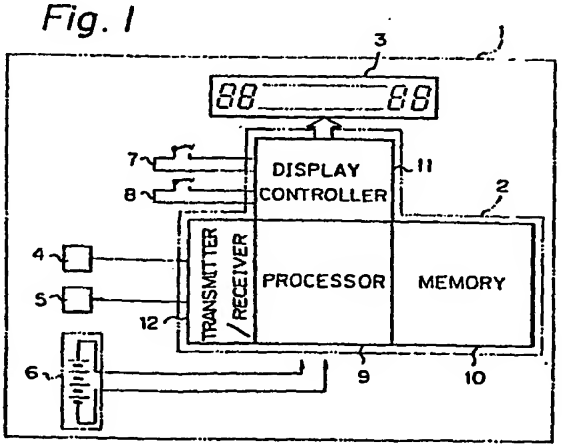
(54) **IC card and IC card reader.**

(57) An IC card includes an integrated circuit composed of a transmitter/receiver, a processor, a memory, and a display controller; a display, and control switches for successively switching data displayed on the display. Desired data stored in the memory can be displayed on the display by a command delivered through the transmitter/receiver or actuation of the control switches. An IC card reader for reading the IC card includes signal transmitting and receiving circuits for transmitting signals to and receiving signals from the IC card, and a control unit for displaying the stored data on the display of the IC card dependent on processed results.

Fig. 1



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DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
Y	GB - A - 2 130 412 (JOHN WOLFGANG HALPERN, WILLIAM WARD) * Totality * --	1-5	G 07 F 7/08 G 06 K 19/06
Y	WO - A1 - 83/03 694 (WILLIAM M. BENTON) * Totality * --	1-4	
Y	GB - A - 2 066 540 (W.LETHABY & CO. LTD.) * Totality * --	1-4	
Y	WO - A1 - 83/03 018 (TELEFONAKTIE-BOLAGET) * Totality * --	5 7	TECHNICAL FIELDS SEARCHED (Int. Cl.4)
Y	IEEE-SPECTRUM, February 1984	5	
A	STEPHEN B. WEINSTEIN, "Smart credit cards: The answer to cashless shopping" pages 43-49 ----	7	G 06 K 19/00 G 07 F 7/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	14-07-1987	BEHMER

CATEGORY OF CITED DOCUMENTS

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